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NION PACIFIC RAILROAD.

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REPORT

ON THE QUESTION OF

BRIDGING THE MISSOURI RIVER,

BY

J. L. WILLIAMS.

NOV. 25, 1867.

FORT WAYNE, IND.:
PRINTED AT THE DAILY GAZETTE OFFICE.

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UNION PACIFIC RAILROAD.

FORT WAYNE, IND., *November* 25, 1867.

OLIVER AMES, Esq.,
President Union Pacific Railroad:

SIR: The controversy between river and land commerce, as connected with bridging the great rivers of the West, which reached its sharpest conflict in the case of the Wheeling and Rock Island Bridges, seems to have found a solution in the adoption of certain features in the plan of building, embodied in the Act of Congress approved 25th July, 1866. This act authorizes bridges at certain points over navigable rivers, with a draw-span of 160 feet on each side of the pivot-pier; or without the draw, in case the lower chord be placed 50 feet above the highest floods. Under its sanction railroad bridges are now under construction over the Mississippi at Quincy and Burlington, and over the Missouri at Kansas City, while at St. Charles, St. Louis, Louisville, Dubuque and other points, plans are being matured.

Surveys heretofore made by the Engineers of the Union Pacific Railroad Company presented three practicable crossings of the Missouri within the range of seven miles above and below Omaha. Maps and profiles of these several routes, with soundings of the river, were placed in my hands when on the line of road in June last, by the Chief Engineer, with the request that I would consider the question in its engineering aspect—his own time being occupied in the reconnoisance of the line to Salt Lake, and that of the consulting Engineer with duties in the mountain region. These engineers are the proper professional advisers

of the Board. Their official reports, made a year ago, were full and satisfactory, so far as the facts were then known. Their estimates were for a wooden bridge, though expressing an opinion in favor of iron. It is only because of further light as to the character of the Missouri that an additional examination was called for.

Certain general principles should guide in the adoption of the plan of bridge, whichever of the crossings shall be adopted, and should have weight in the selection of the route.

1st. PLAN OF LOCATION.

The plan of location should contemplate the avoidance of or cutting down the three miles of 66 feet grade now in use at Omaha, conforming it to the maximum of 30 feet per mile, which, with immaterial exceptions, has been adopted as the permanent ruling grade in locating the entire road to the base of the mountain—517 miles. The large traffic soon to concentrate at the eastern terminus, through the several roads crossing the State of Iowa, from the Missouri Valley Road and the river navigation, should be so carried across the Missouri Valley and the bluff which bounds it on the west, as to connect with this long line of 30* feet grade, without the burden of any steeper ascent on this short intervening section. The true interests of the Company, no less than of the public, will soon demand this change.

2d. ELEVATION OF BRIDGE.

The frequent changes in the boat-channel on this part of the river, so well understood by all connected with its navigation, the strength of the current, increased as it would be by a draw-pier; the possibility of litigation with the diverse interests of river navigation; the expense and contingencies ever attending a draw, and its effect in lessening the working capacity of the bridge for passing trains,

* Note. I learn that the Engineers, in their locations westward, used six-tenths of a foot per 100 feet, which makes the ruling grade really 31.68 feet per mile, instead of 30 feet as before reported. This being the case, this slightly increased maximum has been used in these surveys.

which in times of public emergency might be an evil—all point to a high bridge as the proper form of structure, notwithstanding the greater cost of approaches.

3d. MATERIAL OF BRIDGE.

Wherever located and of whatever height, permanence and exemption from casualties should be a leading consideration. Guided by this general idea, the superstructure should be of iron, on a substantial and approved plan. A timber bridge of long spans, at so great height, if housed, would be exposed to both wind and fire; if unhoused, to early decay.

4th. MASONRY.

The piers and abutments should be strictly of first class masonry, using only stone that will resist the action of the elements for all time. Especial care should be taken in the selection for that part of the masonry between low and high water, where alternate wetting and freezing is so likely to cause disintegration. Granite from the Black Hill range can be delivered by the Railroad Company with only the additional expense of hauling their return construction trains *loaded*, over that of hauling them *empty*, including, of course, a fair allowance for wear and tear of track and machinery—the distance from the granite quarry at Dale Creek being 550 miles. The additional cost of hauling these return trains loaded, according to ascertained results in general freighting on the Pittsburg, Fort Wayne & Chicago railway, would be $\frac{575}{1000}$ cents per ton per mile= $7.00 per cubic yard of stone. Or, allowing for greater wear of freight cars with stone, $8.50 per cubic yard would cover actual cost. This is about $2.50 per yard in excess of the transportation estimate of the best limestone found in the vicinity of the bridge. Seventeen hundred cubic yards would face the piers between low and high water.

Quarries of grey limestone are found in the bluffs of the Platte, some 16 miles southwest from Omaha, and 8 miles distant by wagon road from Papillon Station, on

the U. P. R. R. Specimens shown me appear durable, and the estimates have been made on the basis of facing the piers with this stone. The Bartlett quarries, 24 miles south of Council Bluffs, on the St. Joseph Railroad, will furnish stone that will answer below water, and for backing and protection.

5TH. FOUNDATIONS.

The four points of crosssing for which estimates are herewith submitted, present diverse characteristics of river bed, for each of which plans of foundation should be wisely adapted, and security against undermining attained at whatever cost. In the deep silt soundings, and where the main current flows, cast iron tubes sunk to the depth of 50 or 60 feet below low water, by what is termed the pneumatic* process, can alone be considered certainly safe. In other localities, where the piers may stand rather out of the channel, and are protected by the course of the river, wooden piles, cut off far down, with rip-rap protection in large amount, may form a secure foundation. Where solid rock can be reached with the base of the pier, the case is freed from all uncertainty, and foundations can be safely placed at small comparative cost, depending upon the depth to the rock.

6TH. TRESTLE BRIDGING.

Across the low, overflowed bottom, which here is found chiefly on the east side, the track must be carried for the present, in its ascent to the level of the bridge, by trestle bridging, built of pine timber from the lake region, resting on piles. To what extent the water-way now left open by this trestle over the low land may be safely lessened, can be determined from the ascertained action of the floods upon the river bed, and the influence of increased velocity upon the upward passage of steamboats. With the view of giving the bridge company this option in the future, a liberal length of bridge has been estimated at each of the

* Note. My acknowledgments are due to W. J. McAlpine, civil engineer, for valuable information respecting the sinking of pneumatic piles, in which most American engineers have had so little experience.

proposed sites; and further, the wing walls are so planned in connection with the abutment pier as to be removed and another span added, if necessary, with little loss. As timber shall become still more expensive, the Company may elect in the future to make a permanent earth roadway, which, with a steam excavator and train of cars, can be formed cheaply from the loam bluffs convenient. To enable boats ascending in high water to avail of the slackest current, which will be found toward the end spans on the convex shore, the full height of the bridge should be maintained for its whole length, unless it may be the end span on this shore.

7TH. WIDTH OF BRIDGE.

In maturing these plans, the sufficiency of a single track under emergencies that might arise either in peace or war, should be considered. If an unusual pressure should occur, it will be found that *systematic running of the trains under control of one absolute head*, will so enlarge the capabilities of a single track as to answer all demands, and relieve from the necessity of the *larger outlay required for a double-track bridge*. In the case of the upper crossing, as an illustration, the distance covered by bridge, trestle and high embankment, where extra tracks would be expensive, is $2\frac{1}{2}$ miles. At each end of this bridge section any required number of side tracks could be cheaply laid, upon which trains might accumulate until passed through by the double-track roads west and east. On the bridge the speed would be limited to 6 miles, but averaging for the $2\frac{1}{2}$ miles 8 miles per hour. Thus arranged, railroad superintendents will comprehend the large practicable working capacity of the bridge, in case of need. By running say five or more trains in succession one way and then the same number consecutively in the other direction, with reasonable allowance for delays, sixty to seventy trains could be passed in each direction during each 24 hours, allowing intervals for passenger trains. This rate of transit, with 25 cars per train, would cross over and stand upon the side tracks say 1,600 cars,

carrying, at 6 tons per car, over 9,600 tons daily in the direction of greatest traffic. No such pressure, however, is expected. This statement is designed to show what might be accomplished in case of emergency. The regular working of the bridge, according to the usual time table, with *efficient discipline*, would pass a traffic equal to the largest probable demand.

8TH. VALUE OF A MILE SAVED.

Inasmuch as the several routes across the valley differ materially in length, the value of a mile saved becomes an important element in the comparison. This depends upon the amount of traffic. The present business would not form a fair basis, for it must greatly increase on the completion of the road. Nor would the large traffic of the distant future be a more just criterion; for the cost of construction is a *present investment*, on which interest is to be paid at once. In assuming an amount of tonnage as a fair average basis, it should be considered that the Union Pacific railroad, though likely to be thronged with passengers and the lighter class of freight, and to become a road with large cash receipts in the future, is not to be regarded as peculiarly a road of heavy tonnage, like some of the coal roads of the country. Its through freight will consist rather of light and valuable articles, which, to save time and ocean insurance, can afford to pay high rates by rail. The wheat of California, in its transit to New York, will take the water route. The staple of the Mountains consists chiefly of the ores which, in a crude state, will scarcely bear long transportation. With coal contiguous to work these ores, the machinery and the skilled labor will rather go to the Mountains, creating there a general traffic in both directions.

A careful analysis of the entire transportation expenses on the Pittsburgh, Fort Wayne & Chicago Railway, made by the officers of that Company, for the year 1865, gives $1.06 as the cost of running an average train one mile, including maintenance of way, repairs of machinery, &c. On

the Pennsylvania Central road the cost was $1.93, and on the New York and Erie road $1.50 for the same year. The excess is doubtless owing to the more unfavorable grades and alignment. In these features the Fort Wayne road and the Union Pacific Railroad are alike. Deducting cost of agencies, office and other general expenses, not affected by this difference of distance, the average cost per mile of freight and passenger trains on the Fort Wayne road for 1865 and 1866, was 97 cents. Adding for greater cost of fuel and other items on the Missouri river—coal being 150 miles distant—we may assume $1.20 per mile of train for the case under consideration. Leaving the Board to make their own estimate of traffic in the future, I may state that when it shall amount to three full passenger trains, and five full freight trains, crossing this bridge in each direction, or 16 trains in both directions,* then the daily expense of running each extra mile, after the high grade shall have been reduced to the established maximum, will be, upon this basis, $19.20 per day, which, for 330 days, gives $6,336 as the yearly cost of each mile of increased distance at this point. This is the interest at 8 per cent. on an investment of $79,200.

Traffic received from or transferred to the Missouri river, does not enter into this computation, for the reason that the point of interchange with steamboats remains the same, whatever crossing may be adopted. Nor does the traffic to or from Omaha, either east or west.

On the other hand, it should be borne in mind that, so long as the river connection shall continue at Omaha, any through line crossing below would be chargeable, in the comparison, with the expense of maintaining the track from the point of its connection with such through line. With the lighter wear of rails on this connecting branch, the average expense of keeping up this branch-track at Omaha may be estimatated at $1,350 per mile per annum, which, at 8 per cent., represents a present investment of $16,875.

*Note. Equal to 875 tons of freight, and say 450 passengers daily, in the direction of greatest traffic.

The cost of operating this branch, exclusive of maintenance of way, included above, for local and river traffic, over what this traffic would cost on through trains passing by the initial point, is a further charge against the lines not touching that point. Probably a yearly expense of $650 per mile, representing a present investment of $8,125 for each mile, would cover this somewhat uncertain item.

A reasonable sum as first cost of rolling stock would be a proper charge against each mile of increased length of through line. But as this would be about balanced by rolling stock to operate the Omaha branch chargeable to shorter lines, no estimate is made for this item. There may be other items in the working of the road bearing upon the comparison, but of inconsiderable value and not easily estimated. A basis for comparison between the longer and shorter lines, embracing, in connection with the estimates of construction, every material element, will be found, approximately, in the preceding discussion.

I have not referred to the depreciation in value of the Company's shops by any line crossing below them, nor the injury to fixed interests at Omaha. The value of these considerations, and to what extent they should be considered, are subjects for the Board.

Having presented these general considerations, applicable alike to all points of crossing, I now add a brief description of the lines respectively, referring the Board to the annexed comparative statement A, which gives at a glance the main facts, with estimates of cost.

In the appendix is a comparative summary of total cost of the five lines respectively, stating each item bearing upon the comparison at its value as a *present investment* of capital. This is designed to facilitate the consideration of the general question of location.

LINE No. 1.

CHILDS MILL CROSSING, 5 MILES BELOW OMAHA—HIGH BRIDGE.

Starting from the grounds owned by the Company, 1½ miles southwest of Council Bluffs, this line, crossing the low bottom by a very direct course, intersects the present track in Mud Creek Valley at a point marked T on the map, 8 miles from the Company's repair shops in Omaha, cutting through the narrow ridge dividing that stream from the Missouri to the depth ot 120 feet at the summit. A tunnel here of 800 feet has been adopted in the plans, and is considerably less expensive than an open cut.

Length of line from common point O* to common point T, on present track, 6.24 miles, with maximum grade of 31.68 feet per mile. Bridge proper over river bed, 1680 feet long, consisting of 5 spans of 250 feet each, and 2 shore spans of 215 feet each. To save masonry, the east span here, as at the other high bridges, is estimated as deck bridge. The west abutment and west pier can be founded securely on rock bottom. The next two piers in the main channel, on wooden piles driven to rock, and cut off 32 feet below water. Under the next two piers the rock is too deep to be reached, and cast-iron tubes, sunk by pneumatic process, must be used. The two east piers—one taking the place of the abutment—can be founded on wooden piles cut off at moderate depth. All foundations in this river not resting on rock, will require a further expense for several years in replacing rip-rap protection around the piers, as it shall settle down in the silt. This stone protection will finally assume a broad base, forming in fact an island of stone at each pier. Unceasing vigilance will be required that such protection be added in time. More definite and thorough soundings may indicate the necessity of founding one or two additional piers on pneumatic instead of wooden piles. This would slightly enlarge the estimate.

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*Note. Should this common diverging point be removed three-fourths of a mile north the present fixed interests of Council Bluffs would be better sustained, without increasing the length of any of the lines passing by that place to exchange grounds.

The bottom land on the east side is here overflowed more widely and to a greater depth than at the other crossings. This accounts for the extreme narrowness of the river bed, which will widen when the overflow is contracted.

An advantage of this line, as in Line No. 4, is, that it cuts down all high grades in the first construction, avoiding inconvenience in future. The prominent consideration in its favor is the shortening of through traffic.

Should this line be adopted, the connection with the initial point at Omaha would be over the present track, 8 miles in length from the point of intersection, marked T, in Mud Creek Valley, which line would also form the connection with the river commerce. Or a shorter connection, $6\frac{2}{3}$ miles long, could be built, following the base of the river bluff, uniting with the Childs Mill route a few hundred feet west of the bridge. Upon this plan the 8 miles of road now in use would be abandoned, and the iron removed to the new branch.

LINE No. 2.

LOWER OMAHA CROSSING—HIGH BRIDGE.

This line passes through the south part of Omaha. Its length from common point O, southwest of Council Bluffs, to common point T, on present track, is 9.27 miles; maximum grade, as estimated, 31.68 feet per mile; bridge proper over river bed, 2,500 feet long. The west abutment can be placed on rock, 21 feet below low water, by locating it 425 feet west of present river bank. The safety of the work requires this location of the abutment, and this necessity, with the wide river bed at this point, compels a very long bridge—10 spans of 250 feet each. The river bed here is formed of very light silt, only about 25 per cent. heavier than water, in which the channel is ever changing. The west shore is now 200 feet farther west than in April last. Within the next two or three years the river will undoubtedly reach the proposed site of the west abutment, which,

being founded on rock, will check its further progress in that direction. As the only prudent course, the piers would be founded on cast iron tubes, sunk 60 feet below the water, by pneumatic process, filled with concrete, and capped with wrought iron and timber grillage, on which the pier of masonry is built.

About one-half of the 66 feet grade would be taken out by this location, but the reduction of the remaining $1\frac{1}{2}$ miles can be accomplished only by a very heavy cut, at the summit, 50 feet below the present grade. This could be made within the next seven years, when the material can be used in filling the trestle bridging. The formidable character of this cut, rendered more difficult by the large drainage into it from the surrounding hills; the great expense of bridge foundations manifestly unavoidable, since the treacherous character of the river bed has become better understood, with the great length of the brige, explains the large cost.

It will be noticed that the adoption of this route would unfavorably affect the reduction of the 66 foot grade. The cost of the summit cut being near $200,000, the Company would be slow in undertaking it. To curve into the Ainsworth line from the west end of the bridge, and thus avoid the high grade, is found impracticable. In view of all the facts, this crossing can scarcely be considered feasible. But should it be adopted, the repair shops of the Company and the river navigation would be reached by using the present track from the point of intersection on the high grade, a distance of two miles.

LINE No. 3.

UPPER OMAHA CROSSING—HIGH BRIDGE.

Length of line from common point O to point T, Mud Creek Valley, 12.80 miles. Bridge proper 1,680 feet long, in seven spans, 240 feet each. Piers and abutments all on sold rock. The rock under piers in the middle of river is 8 feet below low water, but dips toward either shore to 14

feet under west, and 17 feet under east abutment below low water.*

No prudent enginer will value lightly the advantages afforded by the rock bottom at this point. Beyond the difference in first cost, as shown by the estimates, it has a value. It is in the nature of a perpetual insurance policy. A bridge here could be erected in four or six months less time than at either of the other crossings proposed, and with less hazard during its progress. When completed, with both abutments on the rock, the river will be held permanently between them.

This line in its extension southwest, passes through 15th Street in Omaha, intersecting present track on the high grade one mile north of the present summit, which is to be cut down, say within 7 years, 35 feet, to bring it to the uniform grade of 31.68 feet per mile, the earth being used to fill the trestle bridge on the bottom instead of renewing it. To maintain this grade, the ascent commences in the north part of the city. The present repair shops could be reached by $2\frac{1}{2}$ miles run on the present track from this intersection, which might become the line of connection with the river. Or, a connecting track, one mile long, could be built from a point a little north of Omaha to the shops, at a cost of about $24,000.

The passage of this route through the city, crossing so many of its streets, is an unfavorable feature, causing some inconvenience to the road and to the citizens when the traffic shall become large.

LINE No. 4.

HIGH BRIDGE.

This route is same as No. 3 from common point O, to a point 3200 feet west of bridge, thence curving to the left, avoids the streets of the city, passing by the repair

* Note. This peculiar conformation of river bed may be owing to the fact that the rock has been but recently uncovered. General Dodge, the Chief Engineer, states, from personal knowledge acquired in his early surveys, that the west bank of the river at this point, as he found it 15 years ago, was then where the east edge of rock is at the present time, having worn its channel westward near 1,800 feet.

shops, and reaching Mud Creek Valley at point T, through the Ainsworth line, along the foot of the river bluff. This line reduces the summit, which is here quite depressed, to 31.68 feet maximum grade in the first construction, as in the Childs Mill line. Length of this route, 12.65 miles. The bridge crossing is the same as on line No. 3, fully and as described under that head, and the advantages of the rock bottom are of course the same.

LINE No. 5.

TELEGRAPH POLE CROSSING—LOW BRIDGE, WITH DRAW.

Length of this line between same points as above 12.10 miles. Crossing the river 1100 feet above Telegraph Pole, it passes by the Company's shops, which indeed were located with reference to this crossing. Its course thence to the common point T, in Mud Creek Valley, is through the Ainsworth line, so called, which was originally run in connection with this crossing, by order of Col. J. H. Simpson, U. S. Engineer, for the purpose of reducing the 3 miles of 66 feet grade to 30 feet per mile, which line is fully described in his report to the Secretary of the Interior, of September 18, 1865. The distinguishing feature of this route is the draw which, unlike the other bridges described, confines boats to one span. The bridge is estimated at 1,750 feet long, having 6 spans of 190 feet each, 1 span 250 feet from center to center, and the draw-span with two openings of 160 feet each in the clear.

Though all these piers will reach the rock, as at the High Bridge, one-fourth of a mile above, yet the east pier finds the rock at the greater depth of $18\frac{1}{2}$ feet, and the east abutment at $28\frac{1}{2}$ feet below low water. This abutment and wings would be founded on large iron cylinders sunk to the rock and filled with concrete. These two foundations, with the draw pier and the two guard piers above and below it, add largely to the cost of this bridge. The short curve and the continual change in the west bank of the river at this crossing, is unfavorable to the easy entrance

of boats into the draw. To guard as far as possible against further changes in the boat channel, the west bank, for some distance above the abutment, should be effectually protected. The estimates embrace a rip-rap protection for two-thirds of a mile, resting on rock. How far this would be effectual in holding the channel, is a question of some uncertainty.

These plans and estimates are based upon the idea that the U. P. R. R. Co. will extend their road across the river, as authorized by the act of Congress, receiving there, on suitable exchange grounds, the traffic of all connecting roads, and making up, on the east side, their through trains for the west. The efficiency of the bridge, and the safety of trains crossing it, require a single management by one road.

The great cost of a permanent work suggests united action. With the business of three eastern roads concentrated upon one substantial iron bridge, a very moderate tariff will pay the interest upon its cost.

The bridging of the Missouri river has been justly considered an undertaking fraught with difficulties. The pioneer work—the Kansas City bridge—as also the two bridges over the Mississippi at Quincy and Burlington, have been in successful progress during the past season, affording, with their deep and varied foundations, actual exrience respecting these rivers not before accessible. I visited these bridges first in July and again in November, and take pleasure in acknowledging the polite attention of the able engineers in charge of these works. Every facility for observation was afforded.

I submit a map of the Valley, embracing a section 14 miles in length, showing the five lines with their connections. Also, plans in detail of the piers and their foundations, upon which estimates have been based.

However the actual cost may vary from the estimates now presented, through the contingencies always attending such work, I have confidence in the fairness of the compa-

rative estimates and plans as between the several lines. Each item of work on the lines, respectively, is estimated at fair relative prices, and the length of bridge proportioned to the demand for water way.

The estimates of iron superstructure are made on the basis of what is known as the "Pratt" or "Linville" truss, as giving the maximum of weight and cost. But this does not indicate a preference for this over other plans alike substantial and safe.

Respectfully submitted,

J. L. WILLIAMS.

A.

Tabular Statement of Estimated Cost, Length, &c., of different Crossings of the Missouri River.

LINES.	Length of line in miles.	Length of Bridge iron truss in feet.	Length of timber trestle bridge in approaches, in ft.	Cost of Bridge proper over river bed.	Cost of approaches, including reducing of 66 feet grade to 30 feet per mile.	Cost of new track required.	Total cost, including reducing grade. ‡	Total present expenditure to open Line for use. ‡	Total ascent and descent in feet.	Height of summit grade ab. low water after cutting down.	Length of new track in miles.
No. 1. — Childs Mill Line, High Bridge....	6.24	1,680	4,700	$981,010	$376,241	$74,880	$1,432,131	$1,432,131	108	88	6.24
No. 2.—Lower Omaha Line, High Bridge....	9.80	2,500	3,950	1,679,958	367,086	46,560	2,093,604	1,896,702	244½	147	3.88
No. 3.—Upper Omaha Line, through 15th st. High Bridge.....	12.80	1,680	5,450	788,867	347,985	84,840	1,221,692*	1,139,822*	304	162	7.07
No. 4.—Same route, connecting with Ainsworth line, HighBr'ge.	12.65	1,680	5,450	788,867	383,359	151,800	1,324,026	1,324,026†	229	94	12.65
No. 5.—Telegraph Pole Line — Low Bridge, with draw.....	12.10	1,750	3,100	864,235	301,428	145,200	1,310,863	1,310,863†	151	94	12.10

* To these totals should be added $,24,000 for the connecting line to the shops, making total cost $1,245,692, and the present cost $1,163,822.

† Should the building of tho Ainsworth line, from Omaha to point T, be postponed for a short time, then the present expenditure to open line over bridge on both routes Nos. 4 and 5 will be reduced $162,491, making total present expenditure on Line No. 4 $1,161,535, and on No. 5 $1,148,372.

‡ Not including cost of right of way.

APPENDIX.

COMPARATIVE SUMMARY.

Constructing and operating the several Lines, reducing all items to their value as a present investment, on the basis of the preceding Report.

LINE No. 1.

CHILDS MILL CROSSING.

Total cost, including reducing 66 feet grade, as per tabubar statement A	$1,432,131
Add $16,875 per mile, present investment, the interest on which would keep up the connecting branch to initial point at Omaha, 8 miles	135,000
Add $8,125 per mile, present investment, the interest on which would operate this 8 mile branch to initial point.	65,000
Total capital	$1,632,131

LINE No. 2.

LOWER OMAHA CROSSING.

Total cost, including reducing 66 feet grade	2,093,604
Add $79,200 per mile, present investment, for through traffic, when it shall reach 16 daily trains, over 3.56 miles extra distance, as compared with Childs Mill crossing	281,952
Add $16,875 per mile, present investment, to keep up connecting branch to initial point at Omaha—2 miles	33,750
Add $8,125 per mile, present investment, the interest on which would operate this two mile branch	16,250
Total capital	$2,425,556

LINE No. 3.

UPPER OMAHA CROSSING—THROUGH 15TH STREET.

Total cost, including reducing 66 feet grade	1,221,693
Add $79,200 per mile, present investment, for through traffic over 6.56 miles extra distance, as compared with Childs Mill crossing	519,552
Add for building connecting line to shops and river commerce, one mile	24,000
Add $16,875, present investment, to maintain this branch —one mile	16,875
Add $8,125 per mile, present investment, the interest on which would operate this branch—one mile	8,125
Total capital	$1,790,244

LINE No. 4.

UPPER OMAHA CROSSING—COINCIDENT WITH LINE NO. 3 FROM COUNCIL BLUFFS TO WEST END OF BRIDGE, THENCE RUNNING BY REPAIR SHOPS.

Total cost, including reducing 66 feet grade, by building the Ainsworth line	$1,324,026
Add $79,200 per mile, present investment, for through traffic over 6.41 miles extra distance, as compared with Childs Mill crossing.*	507,672
Total capital	$1,831,698

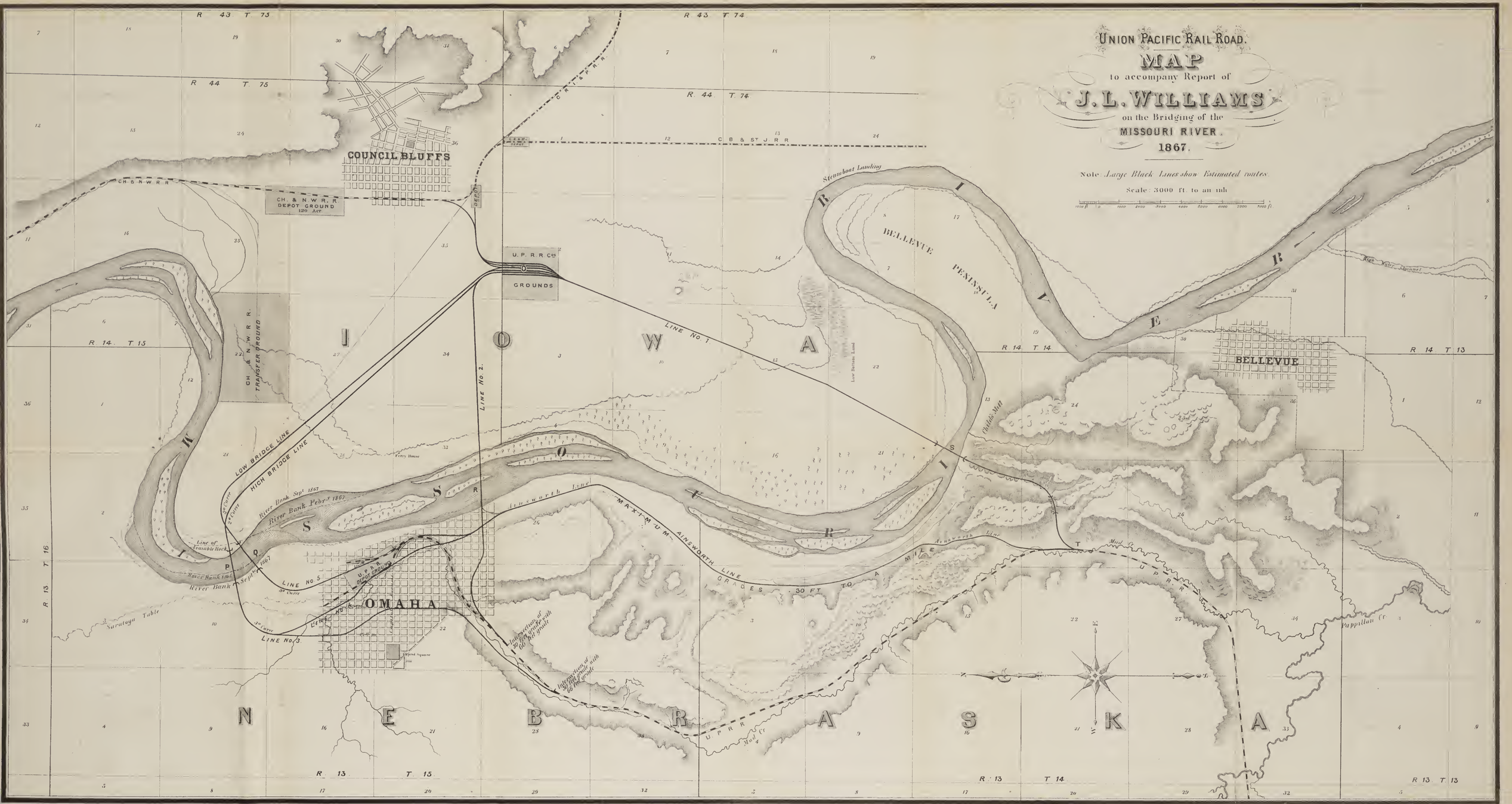
LINE No. 5.

TELEGRAPH POLE CROSSING—DRAW BRIDGE.

Total cost, including reducing 66 feet grade, by building the Ainswortn line	1,310,863
Add $79,200 per mile, present investment, for through traffic over 5.86 miles, as compared with Childs Mill crossing.	464,112
Total capital	$1,774,975

* Note. This is a material item in the comparison. It is largely affected by the position which may be selected for exchange ground, on east side of river, in the final location. If placed three-fourths of a mile north of Point O, then Line No. 1 would be 6.95 miles, and Line No. 4 12.18 miles long, reducing the extra length for through traffic to about 5¼ miles.

Any loss of business on the U. P. R. R. in consequence of a shorter line being hereafter constructed from the east to the Platte Valley, which should bridge the river below or above, is an element in this comparison against the longer lines, but not susceptible of computation.



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